MEMORANDUM

TO: **UTILITIES ADVISORY COMMISSION**

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FROM: **UTILITIES DEPARTMENT**

DATE: **December 6, 2017**

SUBJECT: **Staff Recommendation that the Utilities Advisory Commission Recommend Council Adopt a Hydroelectric Generation Variability Management Strategy**

REQUEST

Staff requests that the Utilities Advisory Commission (UAC) recommend that the Council adopt a hydroelectric (hydro) rate adjustment (HRA) mechanism to help manage the fiscal impacts of hydroelectric generation variability on the electric utility.

EXECUTIVE SUMMARY

In an effort to manage the financial impacts of the annual variability in production of the City's hydroelectric resources, and to allow for the City to maintain a lower target level for its hydro rate stabilization reserve, staff evaluated a number of different hydro variability management strategies, including: holding financial reserves, physical hedges, weather insurance, and hydro rate adjustment mechanisms. This report focuses on staff's recommended strategy: the hydro rate adjuster.

Hydro rate adjustment mechanisms are common tools utilized by utilities with significant exposure to highly variable (year-to-year) hydroelectric resources. The objective of a hydro rate adjuster is to automatically adjust a utility's rates slightly upward or downward on an annual basis in response to hydroelectric conditions, in order to maintain a reasonably stable level of financial reserves. In other words, the hydro rate adjuster is intended to pass through to customers some portion of the variation in the utility's costs resulting from changing hydro conditions. This ensures that the utility's costs are fully recouped annually from ratepayer revenue, without resorting to larger, more permanent rate changes.

In Palo Alto's case, staff devised a hydro rate adjuster that is intended to maintain hydro rate stabilization reserve levels within a range ($3 million to $35 million) at least 80% of the time, based on historical hydro generation conditions. This objective balances the goal of managing hydro variability using a combination of reserves and a rate adjuster while minimizing swings in customer rates.

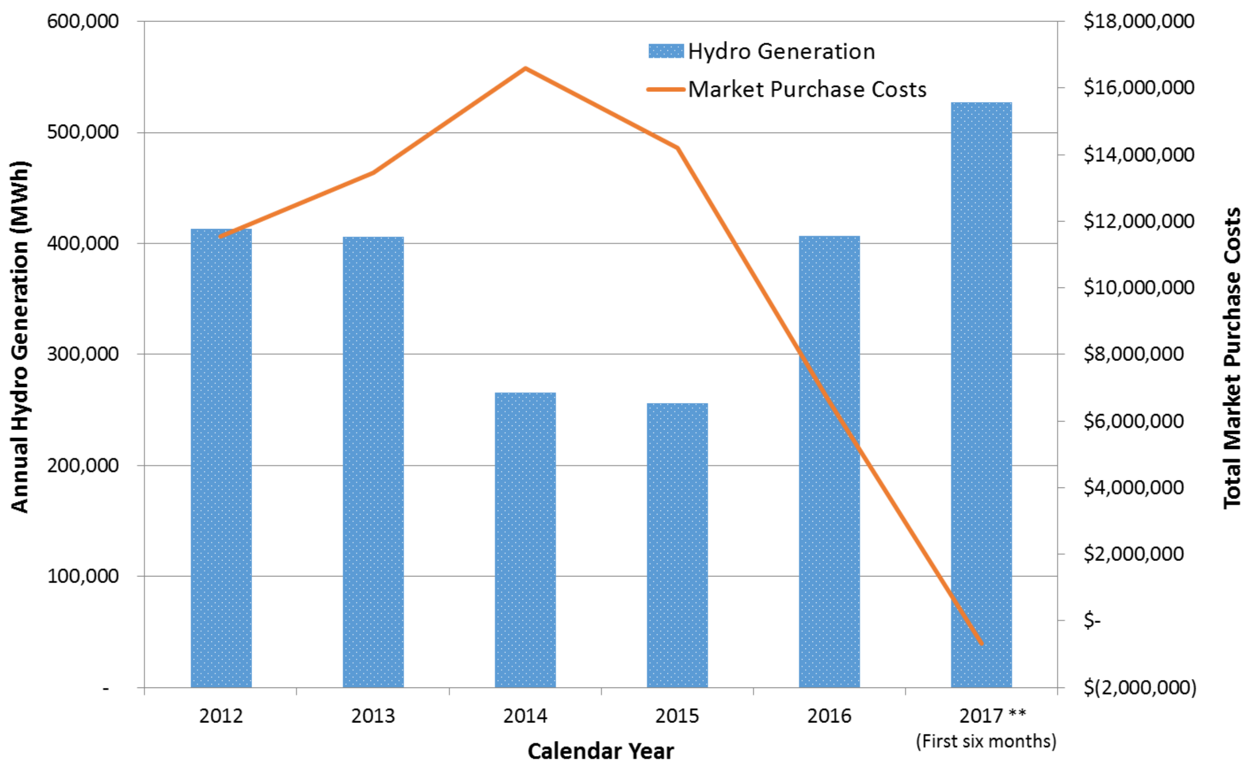
BACKGROUND

The City of Palo Alto is fortunate to have access to a large amount of relatively low-cost, carbon-free hydroelectric generation to meet its electric supply needs. Whereas for the state as a whole hydroelectric generation supplies about 10% of the overall electric supply, the City meets about 50% of its electric supply needs with hydro generation in an average year.

The drawback to maintaining such a heavy reliance on hydroelectric generation, of course, is that the output of these resources is highly sensitive to weather conditions. Although the City receives about 50% of its electric supplies from its hydroelectric resources in a "normal" weather year, that amount can fall to as low as 20% in extremely dry years—such as in 2014 and 2015, the worst years of the recent extended drought. And unlike many of the City's supply contracts, where the cost of the resource is proportional to the amount of generation delivered, the City essentially pays a fixed amount every year for the output of its two hydroelectric resources (Western Base Resource and the Calaveras project) regardless of the amount of electricity they produce. Meanwhile, the City must also purchase additional supply resources (generic market power and, to comply with the Carbon Neutral Plan, renewable energy certificates, or RECs) to make up for the reduced hydroelectric output in these dry years. Compounding the problem, market power prices are often higher in dry years, when the City has to purchase more, because the entire state is experiencing reduced supply conditions.

Figure 1, below, illustrates this relationship between the City's annual market purchase costs and the amount of hydroelectric generation it receives. Market purchase costs depend on other factors as well—namely, market power prices and the amount of renewable energy generation the City receives—but there is clearly a very strong inverse relationship between hydro generation and market purchase costs.

Figure 1: Annual Hydro Generation vs. Market Purchase Costs (2012-2017)



To date, the City's strategy for managing the year-to-year variability of its hydroelectric output has been to hold financial reserves to absorb the resulting swings in its supply costs—to self-insure, in effect. The Council established the Rate Stabilization Reserves (RSRs) in May 1993 (CMR:263:93) for the Water, Electric, Gas and Wastewater Collection Funds, primarily to ensure that funds are available to cover short-term situations when expenditures exceed revenues. However, until 2005 the City did not face much exposure to hydro variability, due to the nature of its Western Base Resource contract at that time. In 2005, when a new Western Base Resource contract allowed the City to begin to experience the full effects of hydro variability, it adopted the current policy of maintaining reserves, combined with a "laddering" approach to making forward market purchases, to manage this variability. At that time, a variety of risk management strategies (including those discussed below) were evaluated, but it was determined that utilizing a physical laddering strategy combined with financial reserves did the best job of maintaining low and stable rates (with "stable rates" being defined as needing to change rates no more than once every two years).

The purpose of this report is to discuss some possible alternative hydro variability management strategies.

DISCUSSION

Staff feels that the best approach to managing the effects of hydro generation variability and satisfying the CPAU Strategic Plan objective of ensuring that customers pay reasonable, and reasonably stable, rates is to implement a Hydro Rate Adjustment mechanism.

Hydro Rate Adjustment Mechanisms

Hydro rate adjusters (HRAs) are mechanisms that automatically pass through to a utility's ratepayers increases or decreases in its supply costs caused by hydrological conditions. At a utility that self-insures but does not utilize an HRA, they might hold rates steady for several years during a moderate drought, gradually drawing down their reserves, before resorting to a large, permanent rate increase in order to replenish those reserves. In addition, the rate increase might go into effect *after* the end of the drought, thereby causing problems for the utility in explaining the cause of the rate increase to its customers. On the other hand, at a utility that utilizes an HRA, they would be able to pass any additional drought-related costs to their customers through a small, ongoing rate increase—which would also be quickly removed at the end of the drought. In this way the utility would likely be able to manage its supply cost fluctuations with a smaller overall level of financial reserves.

HRAs are used by a number of other California municipal utilities, including the Sacramento Municipal Utility District (SMUD) and the City of Roseville. Other utilities use similar types of rate adjustment mechanisms to adjust their customer rates based on other supply cost factors, such as the cost of fuel for electrical generation (particularly coal and natural gas), the cost of transporting that fuel, and transmission costs. In fact, in Palo Alto the gas utility's customer rates include a volumetric "commodity charge" component that passes through to customers on a monthly basis cost changes related to the market price of natural gas. Similarly, in 2015 the water utility instituted a temporary "drought surcharge" on its customers' bills.

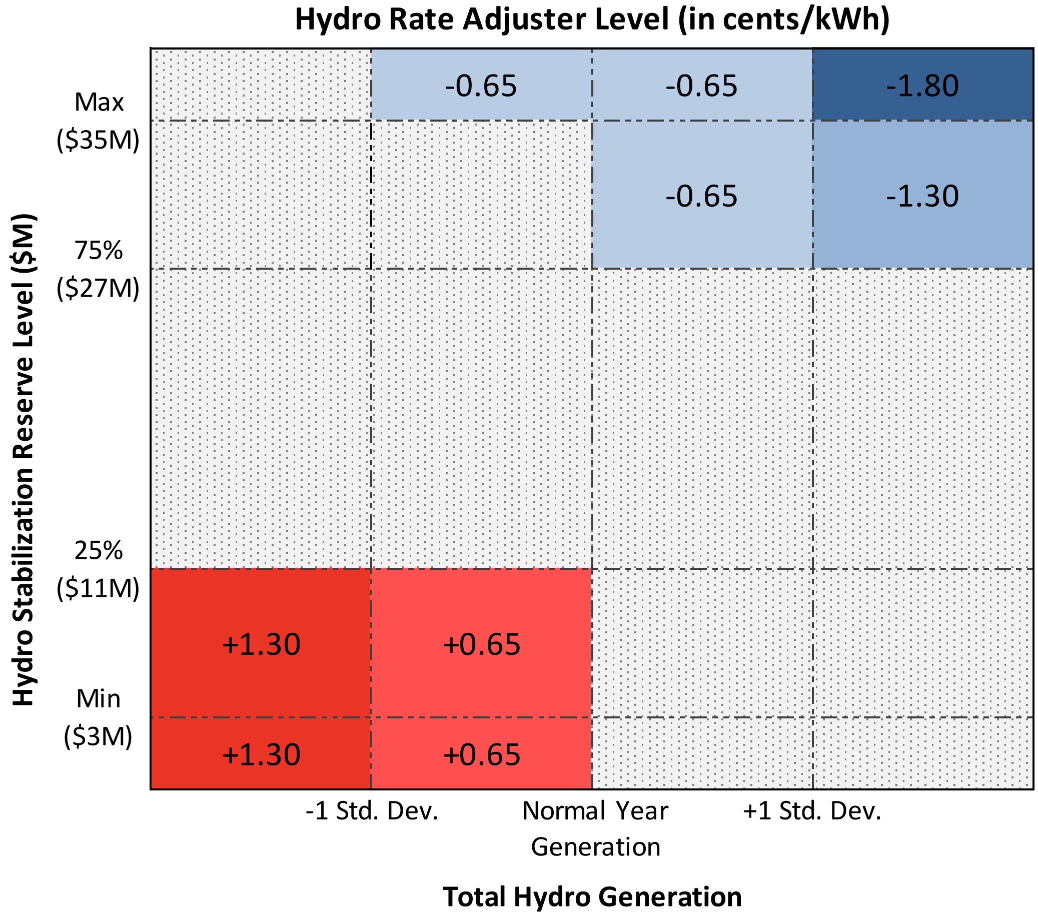
HRA Mechanism Details

The proposed HRA mechanism maintains hydro rate stabilization reserve levels within a certain minimum-to-maximum range ($3 million to $35 million) at least 80% of the time. Under the proposed hydro variability management strategy, the utility will rely on reserves first to manage hydro variability, but when reserves are low, a rate adder will be activated when hydro production is also low to avoid exhausting reserves and to pass on a price signal to customers when low hydro production results in more expensive power. When reserves are high, on the other hand, a rebate will be given to customers when hydro production is high to avoid accumulating excessive reserves and to pass on the benefit of high hydro production to customers.

As designed, the Hydro Rate Adjuster level would be determined in late April or early May each year (at the tail end of the rainy season) and applied to customers' electric rates for the duration of the following fiscal year (July 1 through June 30). In the fall, when staff begins the budget process for the following fiscal year, staff's budget submittals will incorporate its best estimates of hydro generation and supply costs. However, at this point, near the beginning of the rainy season, very little is known about what hydrological conditions will look like in the spring or summer. By the time budget hearings are held with the UAC and Finance Committee, staff will have a better view of the upcoming fiscal year's hydro outlook, and will be able to provide a tentative assessment of whether the HRA mechanism will be applied or not. And finally, in April, once hydro conditions are fairly certain, if the HRA mechanism is to be activated for the next fiscal year, staff will agendize a consent action for Council at the same meeting that the budget is considered for adoption. If approved, the HRA would appear as an independent, transparent line item on customers' bills for the following fiscal year.

The determination of whether or not to apply the HRA, and at what level, would be based on the projected amount of hydroelectric generation for the upcoming fiscal year relative to the amount expected in a "normal" year, and the expected level of the Hydro Stabilization Reserve at the start of the upcoming fiscal year. For years in which reserve levels are relatively high and hydro generation levels are expected to be moderate or greater, customers would receive a slight discount to their regular electric rates; conversely, in years where reserve levels are relatively low and hydro generation levels are expected to be less than average, there will be a slight surcharge applied to customers' regular electric rates. A graphical depiction of how the Hydro Rate Adjuster mechanism is applied based on varying levels of rate stabilization reserves and hydro conditions is displayed in the following chart:

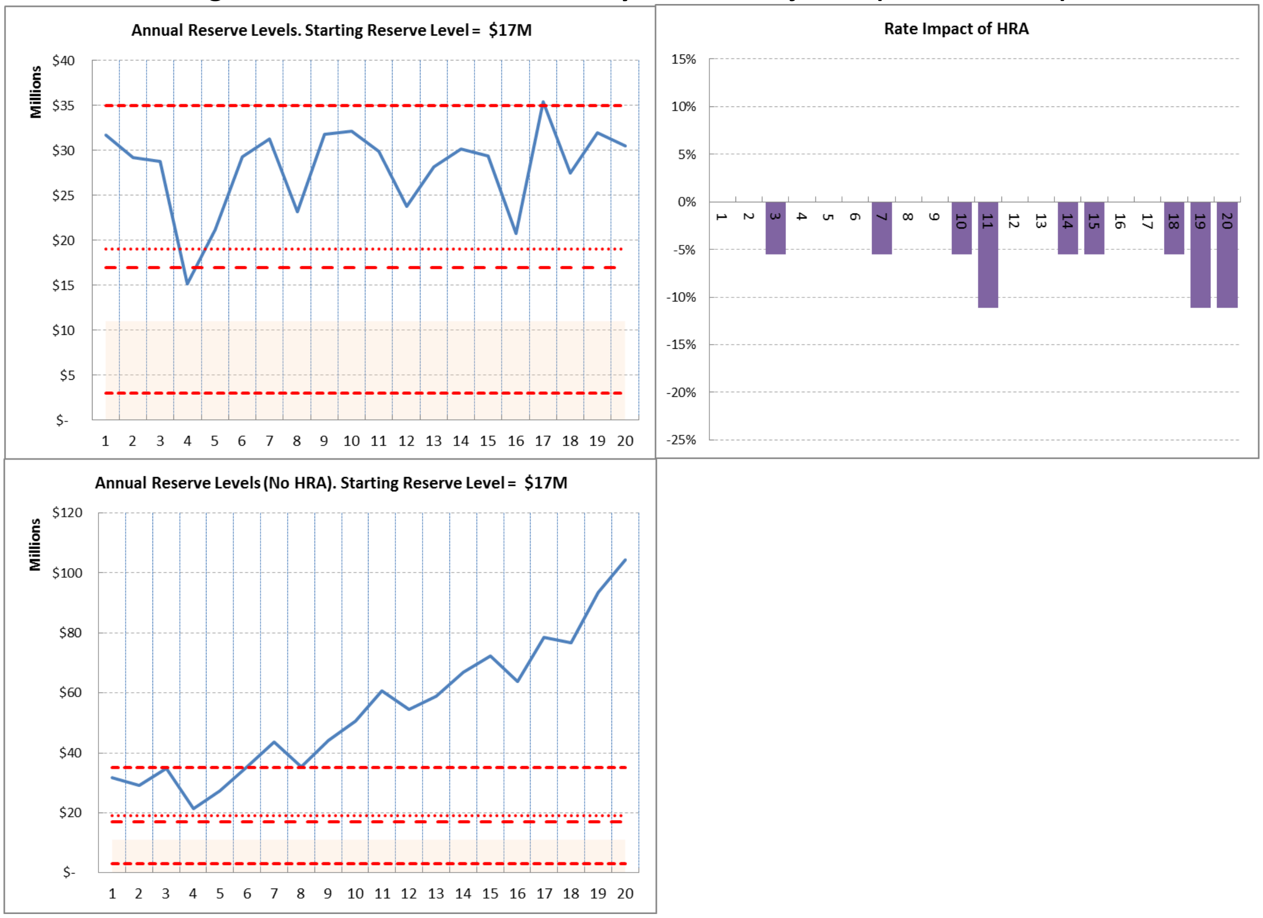
Figure 2: Graphical Depiction of Hydro Rate Adjuster Logic



<u>Simulated Impact of HRA on Reserves and Rates</u>

Using historical hydroelectric generation data, staff developed a model to simulate the effects of the HRA mechanism on Hydro Stabilization Reserve levels and customer rates. The figures below represent one particular 20-year simulation period, with a starting reserve level of $17 million. The upper pair of graphs illustrates the changes in reserve levels and system average rates with the HRA mechanism in effect, whereas the lower graph illustrates the changes in reserve levels for the same 20-year period, with the same hydro generation levels, but without the HRA mechanism being employed.

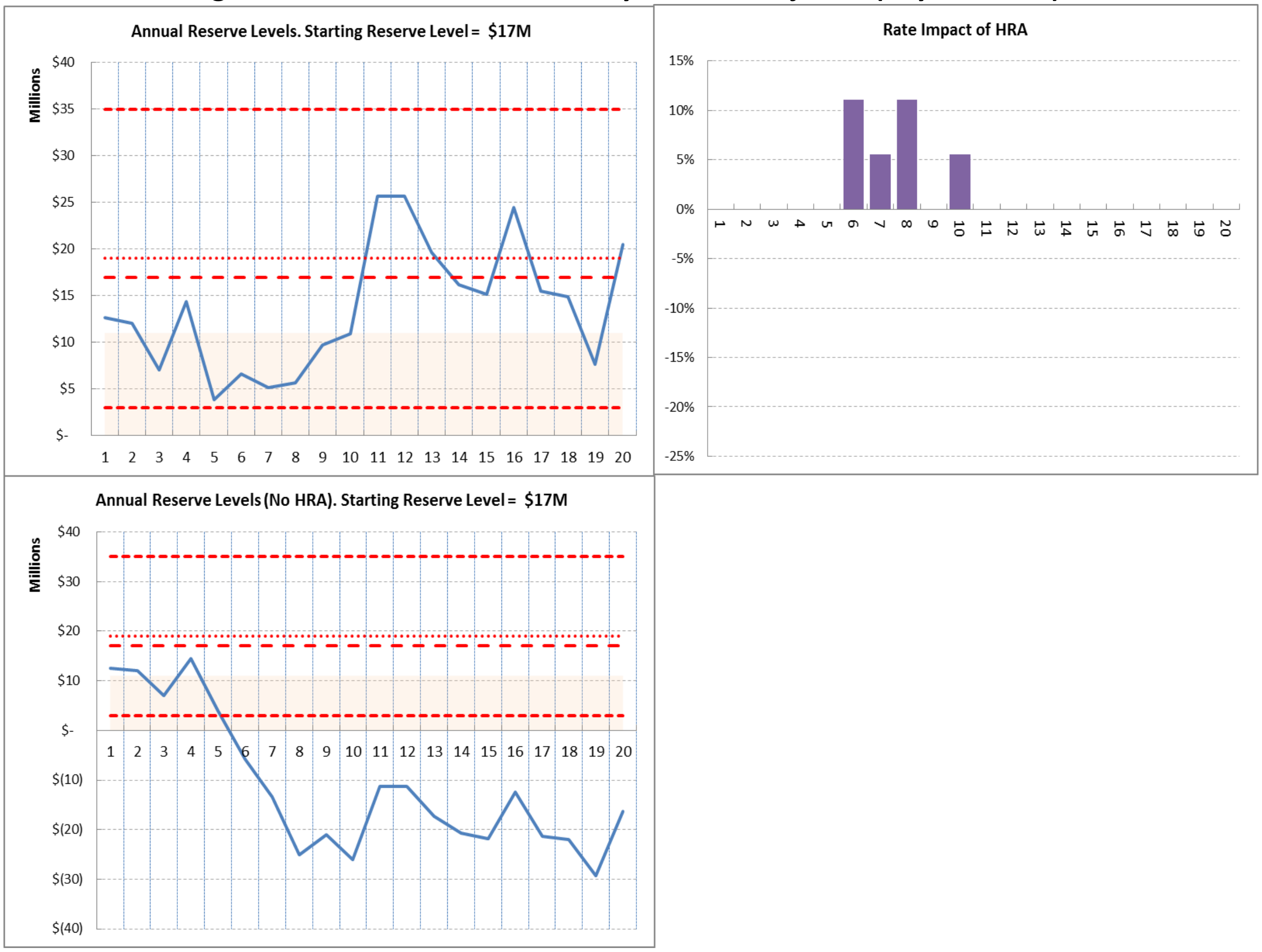
Figure 3: 20-Year Simulation of Hydro Rate Adjuster (Wet Scenario)



Under this simulation run, hydro generation levels are significantly above average for several years during the 20-year period. As a result, the HRA mechanism calls for rebates to be applied during nine of the years in this period; however, these rebates are highly effective in maintaining reserve levels below the maximum level ($35 million). On the other hand, in the absence of the HRA mechanism, reserve levels quickly build up, reaching approximately $105 million by year 20. In reality, under these circumstances the utility would likely implement a significant “permanent” rate reduction around year 10 through the annual Council rate adoption process – a reduction that would likely have to be reversed at a later date (when hydro generation reverts to normal or below normal levels) through a similar process.

On the other hand, during a period of extended drought, the HRA mechanism can help maintain adequate reserve levels which otherwise would fall well below the minimum target reserve level ($3 million). The figures below illustrate such a scenario occurring in another 20-year simulation run. Despite four consecutive years of severely below normal hydro output, the HRA mechanism is able to maintain reserve levels within the min-max band. Absent the HRA mechanism, reserve levels would fall to below -$20 million for an extended period. In this situation again, a Council-adopted “permanent” rate increase would have to be applied and then eventually rescinded once hydro conditions returned to normal.

Figure 4: 20-Year Simulation of Hydro Rate Adjuster (Dry Scenario)



<u>Revenue Impact of HRA Mechanism</u>

As discussed in the City's 2016 electric cost-of-service analysis (COSA), the cost of market energy (the purchase of which the HRA adder is designed to collect for) is allocated entirely based on the kWh consumption of each customer class. A volumetric (per-kWh) adder is therefore a reasonable and appropriate way to collect for the costs associated with below normal hydro output.

Based on the utility's current annual retail sales, a rate adjustment of +/- 0.65 ¢/kWh translates to a revenue adjustment of +/- $6.15 million. Similarly, a rate adjustment of +/- 1.3 ¢/kWh translates to a revenue adjustment of +/- $12.3 million and a rate adjustment of + 1.8 ¢/kWh translates to a revenue adjustment of + $17.0 million. Based on historical hydroelectric generation and market price data for northern California, staff estimates that relative to a normal hydro year, a typical dry or wet hydro year would result in a supply cost impact to the utility of about +/- $8.8 million.

In addition to this recommended approach, staff also evaluated the following alternatives: holding financial reserves (the current approach), physical hedges, and weather insurance and derivative products.

Financial Reserves

Each year, beginning in late fall, staff develops an electric supply budget for the prompt fiscal year, based on the most current precipitation data and reservoir storage conditions. In general though, the precipitation season is not done until the end of April each year; however, at this point it is too late to adjust supply cost projections for the prompt budget cycle, as Council aims to adopt the budget by May. This creates a cash flow uncertainty issue (budgeted supply costs versus actual supply costs), which forces the City to either budget for dry year conditions (i.e., maintain artificially high rates), maintain high reserve levels, or regularly implement mid-year rate changes.

Palo Alto has chosen to address this uncertainty through maintaining high reserve levels. (Although it should be noted that the recent drought has been so severe that the Hydroelectric Stabilization Reserve and Rate Stabilization Reserves have dwindled to unprecedented low levels, even as large rate increases are being implemented.) This strategy is not without its own costs, however. The carrying cost of holding large financial reserves can, depending on interest rates, be quite significant itself. Passing through supply costs changes to customers can permit the City to reduce its targeted reserve levels permanently, thus saving ratepayers money.

The proposed HRA Mechanism operates in a similar manner to the City’s current budget review and rate-setting process, except that under the HRA Mechanism the rate change decision is made in May, using end-of-water-year hydro forecasts and reserve level estimates, rather at the beginning of the water year. By utilizing a clear formula and the most up-to-date information available, the HRA Mechanism is both more transparent and more accurate than the current rate-setting approach. From a financial and environmental sustainability perspective too, it can be valuable to have some variability in customer rates, in that it sends an appropriate price signal to customers – i.e., that they should use less electricity during periods of drought.

Physical Hedges

A physical hedging strategy – that is, one based on the trading of actual electrical generation – can take a variety of forms: seasonal exchanges, laying off a resource, or simple forward trades. The latter approach is already being implemented by CPAU: staff executes physical purchases and/or sales of electricity to try to balance forecasted supplies with load in advance of a given delivery month. This strategy would continue to be implemented even with the adoption of the proposed HRA Mechanism.

The more complex physical hedging strategies essentially amount to transferring the output of the City’s hydro resources – along with the variability risk associated with that generation – to another party. This approach presents several challenges. A seasonal exchange (e.g., the City sending some of its surplus hydro generation to another party during the summer months, while receiving generation from that party in the winter months) would help the City to balance its supply portfolio with its load and would help it reduce the variability risk associated with its supply for the *summer* months; however, it would likely just shift this variability risk over to the *winter* months. In addition, given the nature of hydro generation, there would likely be very few counterparties with an appetite for this type of transaction – i.e., having surplus generation in the winter months and a deficit in the summer months.[1]

A long-term layoff of one of the City's hydroelectric resources would certainly help to alleviate hydro variability risk. However, doing so would also cause the City to lose out on the many products and services that these resources provide—for example, resource adequacy capacity, ancillary services, and load following capability. In addition, over the long-term, the City's hydroelectric resources have proven to be a low-cost source of large volumes of carbon neutral electricity. The City may ultimately find that laying off some or all of its hydroelectric generating capacity would be to its benefit. However, this decision should be made as part of a comprehensive and in-depth analysis of the City's supply portfolio along with the alternative supply resources available to it.

Weather Insurance

Just like insurance that protects people against earthquakes, floods, fires, and automobile collisions, insurance sellers also offer insurance and derivative products to protect buyers against weather-related risk. These policies are highly customizable, and can be tailored to protect against a wide range of different conditions, such as temperature, precipitation, sun, or wind. Farmers, ski resorts, outdoor festivals, and golf courses are often buyers of such weather protection contracts.

For an electric utility like the City with a large concentration of hydroelectric resources, a weather insurance contract would typically be structured to pay out based on the total precipitation measured at one or more weather stations over the course of a year. Although total precipitation is not a perfect proxy for hydroelectric output (particularly for a complex system like the Central Valley Project, which provides the City's Western Base Resource output, and which also serves a number of other purposes, such as irrigation and recreation), there is typically a strong correlation between the two. Another challenge in structuring a weather insurance contract is in selecting a weather station or group of weather stations that most accurately reflect the hydrological conditions of the watershed(s) that feed into the utility's hydroelectric generators. Palo Alto's hydroelectric resources are spread across central and northern California, so a single weather station would likely do a poor job of representing hydrological conditions at all of these facilities, so an index comprising numerous weather stations would likely need to be created. The trade-off is that the more complex a weather station index becomes, the higher the annual premium (cost) the resulting weather protection contract will likely carry.

There are many different ways to structure a precipitation-based weather insurance contract. The primary factors that must be considered are: (a) the precipitation level at which the

[1] From 1993 to 2008, the City participated (along with other NCPA members) in a seasonal exchange with Seattle City Light (SCL). In this transaction, SCL delivered approximately 10 MW of power around-the-clock to Palo Alto in the summer (June through mid-October), while Palo Alto delivered 10 MW of power to SCL in the winter (mid-November through April). Thus the transaction was designed not so much to balance the City's supply portfolio with its load, but to take advantage of a summer-versus-winter price arbitrage opportunity. Ultimately the City found the exchange to be of negative value, and laid off its share of it to another NCPA member in 2008.

contract begins paying out, (b) the maximum payout, and (c) the incremental payout levels. The values chosen for these key factors will determine the annual premium of the contract. However, it is also possible to structure a contract such that the annual premium is reduced or even eliminated. This can be done by requiring that, in addition to the utility receiving a payment from the insurer when certain dry conditions exist, the utility pays the insurer in wetter years. (This type of structure is referred to as a "costless collar.")

Staff is aware of at least one public utility in California (SMUD) that procures weather insurance as part of a comprehensive hydro variability management strategy that also involves financial reserves, physical hedging, and a hydro rate adjuster. Starting around 2001, SMUD – which in a normal year receives about 15-20% of its electricity supply from hydro resources – began procuring costless collar insurance coverage to ensure rate stability. However, they soon found that this type of insurance contract limited their upside (wet year) benefits too severely. So they stopped doing costless collar contracts and focused more on self-insurance (by increasing their financial reserves and adopting a hydro rate adjuster). For the past several years, SMUD has procured multi-year simple (one-sided) insurance contracts to protect against extreme dry conditions – when precipitation levels are less than half of what they area in an average year. In SMUD's experience, these extreme "tail" insurance contracts have never paid out to them. However, SMUD has also procured a smaller amount of insurance coverage to protect against moderately dry years (when precipitation levels are between 50 and 70% of average), and these contracts have in fact paid out to them in a couple of years.

The main benefit of using weather insurance is that, if the insurance contract is designed well, it is very effective at mitigating the adverse financial impacts (and, if desired, the favorable financial impacts as well) of hydro generation variability. In addition, the triggering event in a weather insurance contract (precipitation levels at a weather station, in this example) is a very objective and transparent measure.

The downside of weather insurance, of course, is its cost. Although an insurance policy will mitigate the adverse risk associated with hydro variability, it will also cost a considerable amount every single year (for a one-sided contract, where the utility never pays the insurer) or it will mitigate the favorable risk as well (for a two-sided, or costless collar, contract). Staff has evaluated weather insurance options numerous times in the past and always found them to be prohibitively expensive relative to the self-insurance (financial reserves) option; this time is no different. The table below provides indicative pricing for a variety of different types of insurance contracts. In each case, either the annual premium is very high or the likelihood of a payout to the City is very remote.

Table 1: Indicative Pricing for Select Weather Insurance Contracts

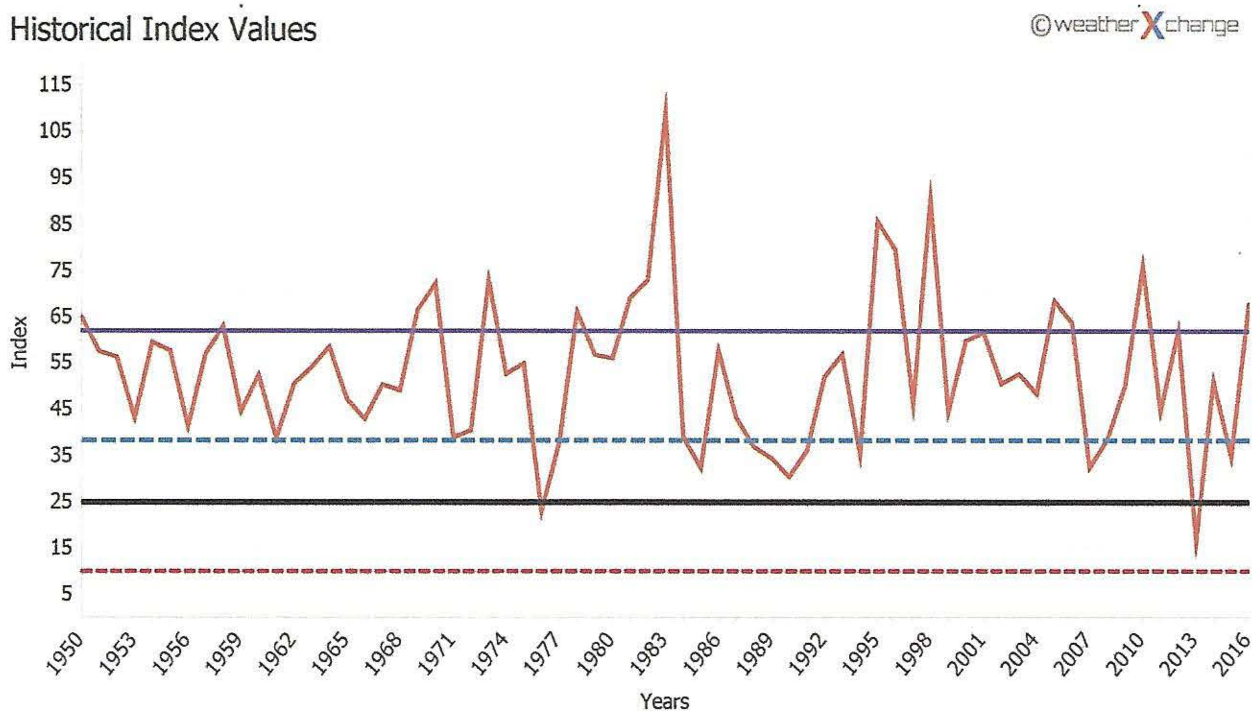
Structure	Put	Put	Put	Put	Put	Put	Costless Collar
Term (yrs)	1	5	1	5	1	5	1
Inception	1/1/18	1/1/18	1/1/18	1/1/18	1/1/18	1/1/18	1/1/18
Expiry	12/31/18	12/31/22	12/31/18	12/31/22	12/31/18	12/31/22	12/31/18
Put Strike (in.)	10	10	25	25	37	37	25
Call Strike (in.)	--	--	--	--	--	--	63
Tick ($/in.)	2,000,000	2,000,000	400,000	400,000	400,000	400,000	400,000
Annual Limit ($)	8,000,000	8,000,000	6,000,000	6,000,000	6,000,000	6,000,000	6,000,000
5yr Limit ($)	--	24,000,000	--	15,000,000	--	15,000,000	--
Annual Premium ($)	475,000	355,000	709,100	555,700	1,153,700	967,600	0

In Table 1 above, a “Put” structure is a simple one-sided insurance contract (protecting the City against downside risk), the “Put Strike” is the annual precipitation level below which the City would start receiving payment, the “Call Strike” is the annual precipitation level above which the City would have to pay the insurance seller (for the “Costless Collar” contract structure), the “Tick” is the dollar amount that the City would receive (or pay) for every inch the precipitation level falls below the Put Strike (or exceeds the Call Strike).

The indicative pricing above was quoted by a well-known weather insurance seller for an index of northern and central California weather stations that represent the City’s hydro generation resources and watersheds quite well. For this index of weather stations, the long-term average annual precipitation level (since 1950) is 53.1 inches. Figure 5 below shows the long-term history of annual precipitation for this group of weather stations, along with lines denoting the various put/call strike levels listed in Table 1 above.

The first two contracts listed in Table 1 are reasonably priced (premiums of about $400,000 per year), but they only protect the City against precipitation levels below 10 inches – an extreme drought condition that, as Figure 5 indicates, has not been experienced in the last 67 years. The next two contract structures, with a 25 inch strike, are a bit more expensive ($500,000-$700,000 per year) and would only have paid out to the City in two of the last 67 years (2013 and 1976). The next two contract structures, with a 37 inch strike, provide a moderate level of protection to the City – they would have paid out three times in the last ten years (2015, 2013, 2007) – but they cost approximately $1 million per year. And finally, the last column of Table 1 shows the terms of a costless collar (two-sided) contract structure. In exchange for protection against sub-25 inch precipitation conditions (which, again, have occurred only twice in the last 67 years), the City would have to pay the insurance seller in any year in which precipitation levels exceed 63 inches. As shown in Figure 5 below, wet conditions like this have occurred in eight of the last 25 years and in 15 of the last 67 years. Thus this “free” option would provide little protection to the City and would actually come at a fairly high cost.

Figure 5: Historical Index Precipitation Levels and Selected Put/Call Strikes



NEXT STEPS

After receiving the UAC's recommendation, staff will take the HRA mechanism discussion to the Finance Committee, followed by consideration by the City Council. If adopted by the City Council, the HRA mechanism would go into effect on July 1, 2018.

RESOURCE IMPACT

The Hydro Rate Adjustment mechanism is designed to modify customer rates, either up or down, such that overall sales revenue is aligned with supply costs for the electric utility.

POLICY IMPLICATIONS

The adoption of a Hydro Rate Adjustment mechanism supports the Utilities Strategic Plan objective that customers should expect to pay reasonable, and reasonably stable, bills.

ENVIRONMENTAL REVIEW

Adoption of a Hydro Rate Adjustment mechanism does not meet the definition of a project, under Public Resources Code Section 21065 and CEQA Guidelines Section 15378(b)(5), because it is an administrative governmental activity which will not cause a direct or indirect physical change in the environment, thus no environmental review is required.

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